Option-implied expectations and monetary policy

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Research Questions

- Is monetary policy able to influence or manage investors' expectations about the future state of the economy?
- And more importantly, are policy makers able to shape investors' expectations about the long-term horizon?

In this paper, our purpose is to examine the impact of monetary policy on investors' expectation about the future state of the economy

Literature review

Relevant studies

Relevant studies on monetary policy and stock market performance:

- The relationship between the monetary policy changes and the subsequent stock returns (Thorbecke (1997), Rigobon and Sack (2004), Bernanke and Kuttner (2005), Gorodnichenko and Weber (2016), Lucca and Moench (2016))

Bernanke and Kuttner (2005) find that unanticipated monetary policy actions influence equities prices, by affecting expected future excess returns or expected future dividends.

- Also, many papers empirically verify the “Greenspan put” phenomenon (Rigobon and Sack, 2003; Kurov et al., 2019; Kurov et al., 2016; Gu et al., 2018; Cieslak and Vissing-Jorgensen, 2020).

Kurov et al. (2016) document an omitted variable bias and endogeneity issues regarding policy actions, when they estimate the monetary policy impact on asset prices during periods of stock market uncertainty.

Cieslak and Vissing-Jorgensen (2020) find that policy makers pay attention to stock market performance, by implementing a textual analysis on FOMC announcements.

Relevant studies

Relevant studies on Risk taking channel of monetary policy:

- The impact of monetary policy decisions on

1. investors' uncertainty (Bekaert et al. (2013), Vahamma and Aijo (2011), Rosa (2011), Cospodinov and Jamali (2012), Clements (2007), Du et al (2018))

2. investors risk aversion (Bekaert et al (2013), Adrian and Shin (2008), Ioannidou et al (2015))

3. jump tail risk of the equities market (Hattori et al (2016), Beckmeyer et al (2019))

Vahamma and Aijo (2011), Rosa (2011), amongst others, use option-implied volatility to proxy investors expectations, while Hattori et al (2016), Beckmeyer et al (2019) use higher moments of option implied distribution such as skewness and kurtosis to proxy risk aversion and jump tail risk.

Relevant studies

Relevant studies on risk neutral moments:

- Option-implied information is inherently forward-looking and reflects investors' beliefs under the risk-neutral measure about the upcoming evolution of the underlying equities prices (Bates, 1991; Jackwerth and Rubinstein, 1996; Bakshi et al., 1997)

- Working with option prices is convenient because contrary to the stock prices, option prices are available for a spectrum of strike prices which allows us to infer the whole market's risk-neutral distribution, RND, over the underlying price (Breeden and Litzenberger (1978))

- Skewness has become a proxy for investors' expected tail risk of the return distribution (Kraus and Litzenberger (1976, 1983), Bates (1991), Jackwerth and Rubinstein (1996), amongst others.

Jackwerth and Rubinstein (1996) document that risk-neutral distributions have become more skewed and leptokurtic after the crash in 1987

Contribution

- In contrast with many relevant studies, we estimate the reaction of the third and fourth moments (skewness and kurtosis) of the risk neutral distribution on monetary policy shocks.

- The contribution of this paper in the relevant literature is twofold.

1. In line with the results on the relevant literature, our analysis shows that expansionary monetary policy revises upwards the expectations regarding to equity prices (risk neutral skewness becomes less negative). This result is in line with the "Fed Put" phenomenon.

2. We find that long-term option-implied expectations are more sensitive to monetary policy shocks, when compared with the monetary sensitivity of short-term option-implied expectations.

Methodology

Methodology (monetary policy stance)

- In our analysis, we proxy the monetary policy stance by following Bekaert et al (2013) and Triantafyllou and Dotsis (2017).
- The measures of monetary policy stance:

1. the fed fund target rate (FFR).
2. the real interest rate (RIR), that is the Fed funds rate target rate minus the CPI annual inflation rate,
3. the growth rate of the monetary aggregate M1 (M1growth),
4. and finally, the Taylor rule rate (or Taylor rule deviation, TRD)

Additionally, we estimate the monthly monetary policy shocks similarly to Guo, Kontonikas and Maio (2020),by using changes on 3-month Fed fund futures and 8-quarter ahead Eurodollar contracts during the FOMC announcement days.

Methodology (proxy of investors’ expectations and fears)

- We estimate the higher moments of the option-implied distribution (risk neutral density) of the upcoming equities returns, by following the model-free methodology of Bakshi et al (2003)

- Our approach have the following advantages:

1. the information embedded in option prices is forward-looking, as opposed to historical data which is backward-looking

2. We do not need to apply any specific assumptions about the investors’ preferences

3. Since options are priced considering an expiration period of τ days ahead (the option expiration or maturity), the information embedded in these prices reflects investors’ expectations about future states of the economy over a specific horizon τ.

Methodology (proxy of investors' expectations and fears)

Bakshi et al (2003) Methodology

The τ-period return from time t is defined by Bakshi et al (2003) as: $R(t,\tau) \equiv ln[S(t,\tau)] - ln[S(t)]$, where $S(t,\tau)$ designates the price of the stock at time t which has τ time remaining to maturity.

Bakshi et al (2003) show that under the martingale pricing measures, the risk-neural skewness and kurtosis can be inferred from OTM call and put options as,

$$SKEWNESS(t,\tau) \equiv \frac{\mathcal{E}_t^*\{(R(t,\tau)-\mathcal{E}_t^*[R(t,\tau)])^3\}}{\{\mathcal{E}_t^*\left(R(t,\tau)-\mathcal{E}_t^*[R(t,\tau)]\right)^2\}^{3/2}}$$

$$= \frac{e^{r\tau}W(t,\tau)-3\mu(t,\tau)e^{r\tau}V(t,\tau)+2\mu(t,\tau)^3}{[e^{r\tau}V(t,\tau)-\mu(t,\tau)^2]^{3/2}}$$

$$KURTOSIS(t,\tau) \equiv \frac{\mathcal{E}_t^*\{(R(t,\tau)-\mathcal{E}_t^*[R(t,\tau)])^4\}}{\{\mathcal{E}_t^*\left(R(t,\tau)-\mathcal{E}_t^*[R(t,\tau)]\right)^2\}^2} =$$

$$= \frac{e^{r\tau}X(t,\tau)-4\mu(t,\tau)e^{r\tau}W(t,\tau)+6e^{r\tau}\mu(t,\tau)^2V(t,\tau)-3\mu(t,\tau)^4}{[e^{r\tau}V(t,\tau)-\mu(t,\tau)^2]^2}$$

where $\mathcal{E}_t^*$ is the expectation operator under the risk-neutral density and $\mu(t,\tau)$ is defined as,

$$\mu(t,\tau) \equiv \mathcal{E}_t^* ln\left[\frac{S(t,\tau)}{S(t)}\right] = e^{r\tau} - 1 - \frac{e^{r\tau}}{2}V(t,\tau) - \frac{e^{r\tau}}{6}W(t,\tau) - \frac{e^{r\tau}}{24}X(t,\tau)$$

Methodology (proxy of investors' expectations and fears)

Bakshi et al (2003) Methodology

The volatility contract $V(t,\tau) \equiv \mathcal{E}_t^*\{e^{-r\tau}R(t,\tau)^2\}$, the cubic contract $W(t,\tau) \equiv \mathcal{E}_t^*\{e^{-r\tau}R(t,\tau)^3\}$ and the quartic contract $X(t,\tau) \equiv \mathcal{E}_t^*\{e^{-r\tau}R(t,\tau)^4\}$ payoffs are defined as,

$$V(t,\tau) \quad = \int_{S(t)}^{\infty} \frac{2\left(1-ln\left[\frac{K}{S(t)}\right]\right)}{K^2} C(t,\tau;K)dK$$

$$+ \int_{0}^{S(t)} \frac{2\left(1+ln\left[\frac{S(t)}{K}\right]\right)}{K^2} P(t,\tau;K)dK$$

$$W(t,\tau) \quad = \int_{S(t)}^{\infty} \frac{6ln\left[\frac{K}{S(t)}\right]-3\left(ln\left[\frac{K}{S(t)}\right]\right)^2}{K^2} C(t,\tau;K)dK$$

$$- \int_{0}^{S(t)} \frac{6ln\left[\frac{S(t)}{K}\right]+3\left(ln\left[\frac{S(t)}{K}\right]\right)^2}{K^2} P(t,\tau;K)dK$$

$$X(t,\tau) \quad = \int_{S(t)}^{\infty} \frac{12\left(ln\left[\frac{K}{S(t)}\right]\right)^2-4\left(ln\left[\frac{K}{S(t)}\right]\right)^3}{K^2} C(t,\tau;K)dK$$

$$+ \int_{0}^{S(t)} \frac{12ln\left(\left[\frac{S(t)}{K}\right]\right)^2+4\left(ln\left[\frac{S(t)}{K}\right]\right)^3}{K^2} P(t,\tau;K)dK$$

where K is the strike price, $S(t)$ is the underlying stock price at time t, and $C(t,\tau;K)$ and $P(t,\tau;K)$ represent the price of the European call and put, respectively, on day t, with τ days to maturity and strike price K.

Term structure of option-implied moments

- We estimate the term structure of option-implied skewness and kurtosis using the estimated risk neutral moments for 8 maturities (1 to 12 months)

- We estimate for each term structure of option-implied moments the following components:

1. the term spread, as the difference of the 365 days maturity and 30 days maturity implied moment
2. the level as the average of all the estimated implied moments for each maturity,
3. the short-end component as the average of the 1,2- and 3-months implied moments
4. The long-end component as the average of 6,9- and 12-months implied moments

Econometric approach (Structural VAR models)

We estimate bivariate/multivariate SVAR model similarly to Bekaert et al (2013) and Triantafyllou and Dotsis (2017)

We use short-run and long-run restrictions on the estimated SVAR models.

Forms of the main multivariate models : $Y_t = [IPG_t \; MP_t \; IS_t \; IV_t]$ and $Y_t = [IPG_t \; MP_t \; IK_t \; IV_t]$

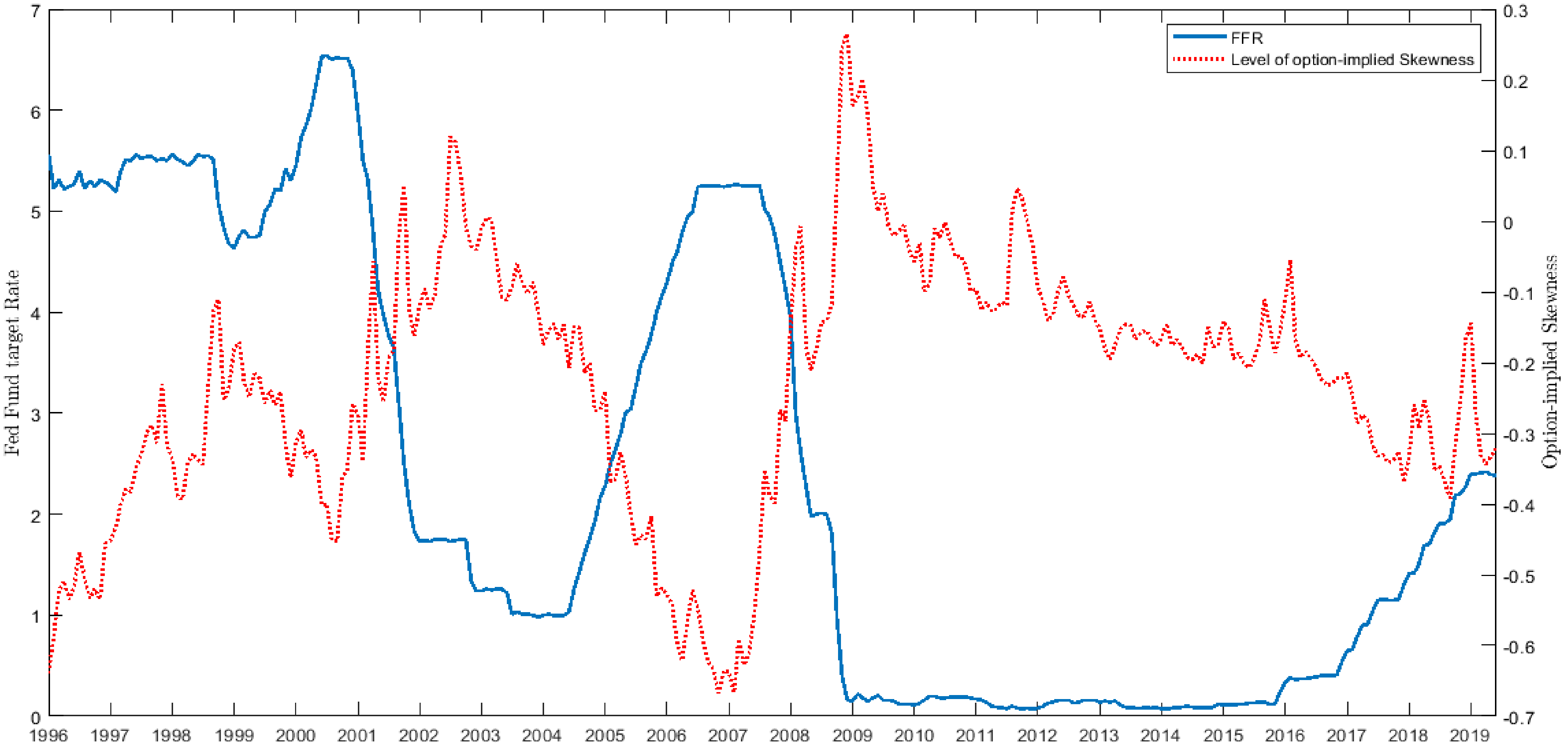
- Short-run restrictions: The market-based measures (option-implied moments) do not have a contemporaneous (short-run) effect on monetary policy and other macroeconomic variables. The SVAR models with the short run restriction are the following:
- $$AY_t = \gamma + BY_{t-1} + \varepsilon_t$$
- $$B = \begin{bmatrix} \beta_{11} & 0 & \cdots & 0 \\ \beta_{21} & & \ddots & \vdots \\ \vdots & & & 0 \\ \beta_{n1} & \beta_{n2} & \cdots & \beta_{n1} \end{bmatrix}$$

- Long-run restrictions: These restrictions are based on the results of the relevant literature about the long-term money neutrality (Lucas (1972), Barro (1977), Bernarke and Mihov (1998)). Following Blanchard and Quah (1989), the SVAR model with the long-run restrictions has the following long-run response matrix:
- $C = (I - A^{-1}B)^{-1}B^{-1}$

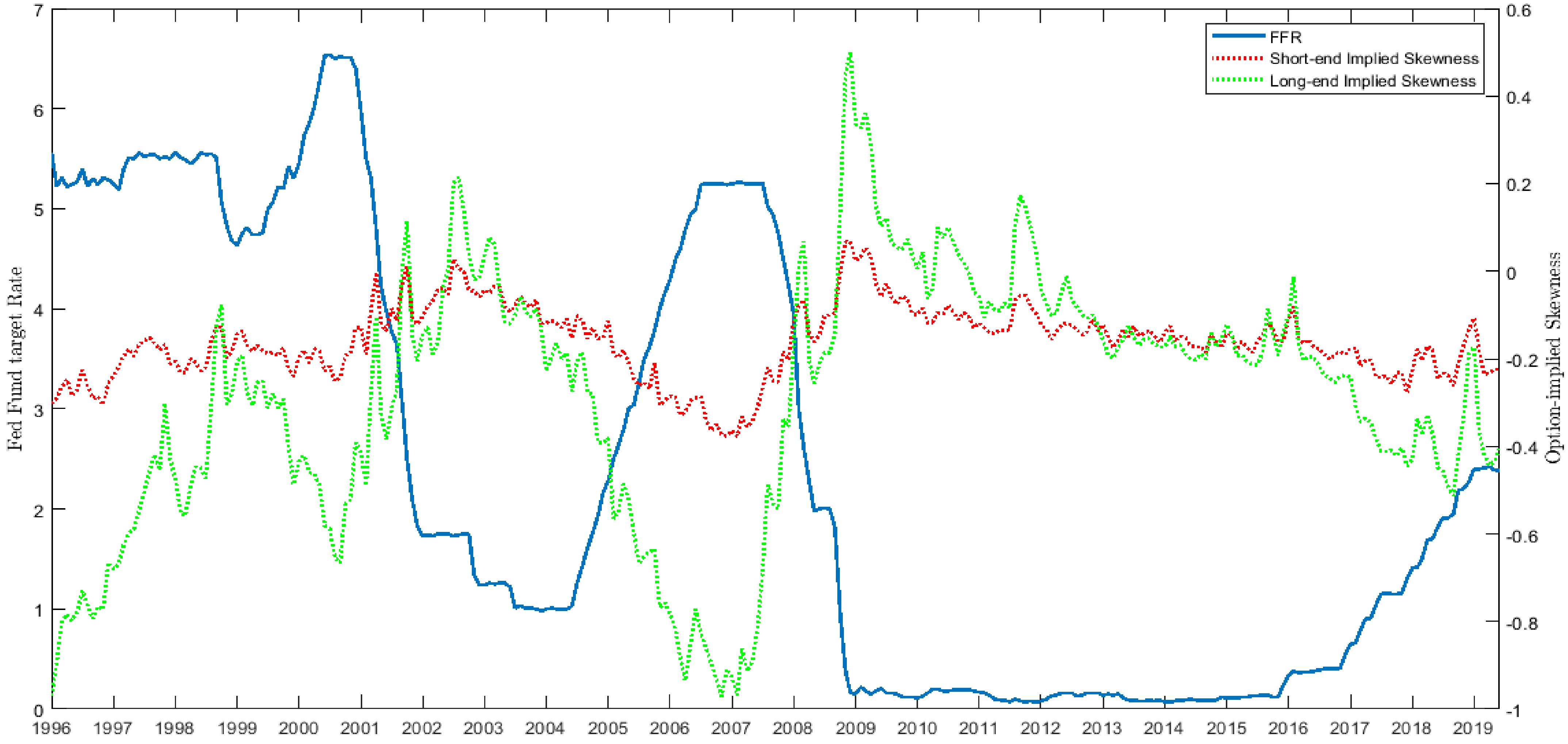
The estimated results are based on structural-form Impulse Response Function (SIRFs thereafter) for which, we estimate the 90% bootstrapped confidence intervals based on 1000 replications.

Empirical results

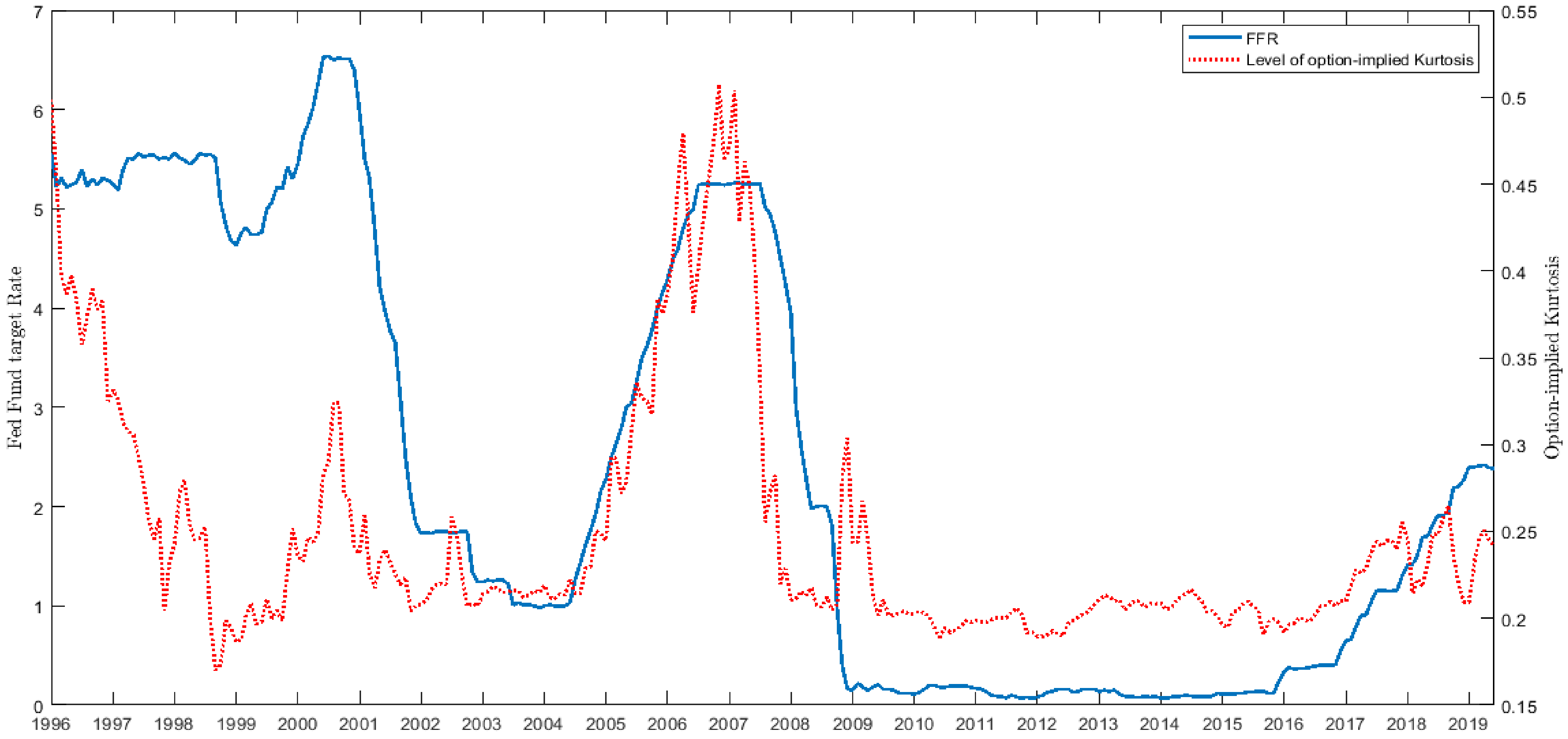
Plot of the monthly level of the option-implied skewness and the fed fund rate



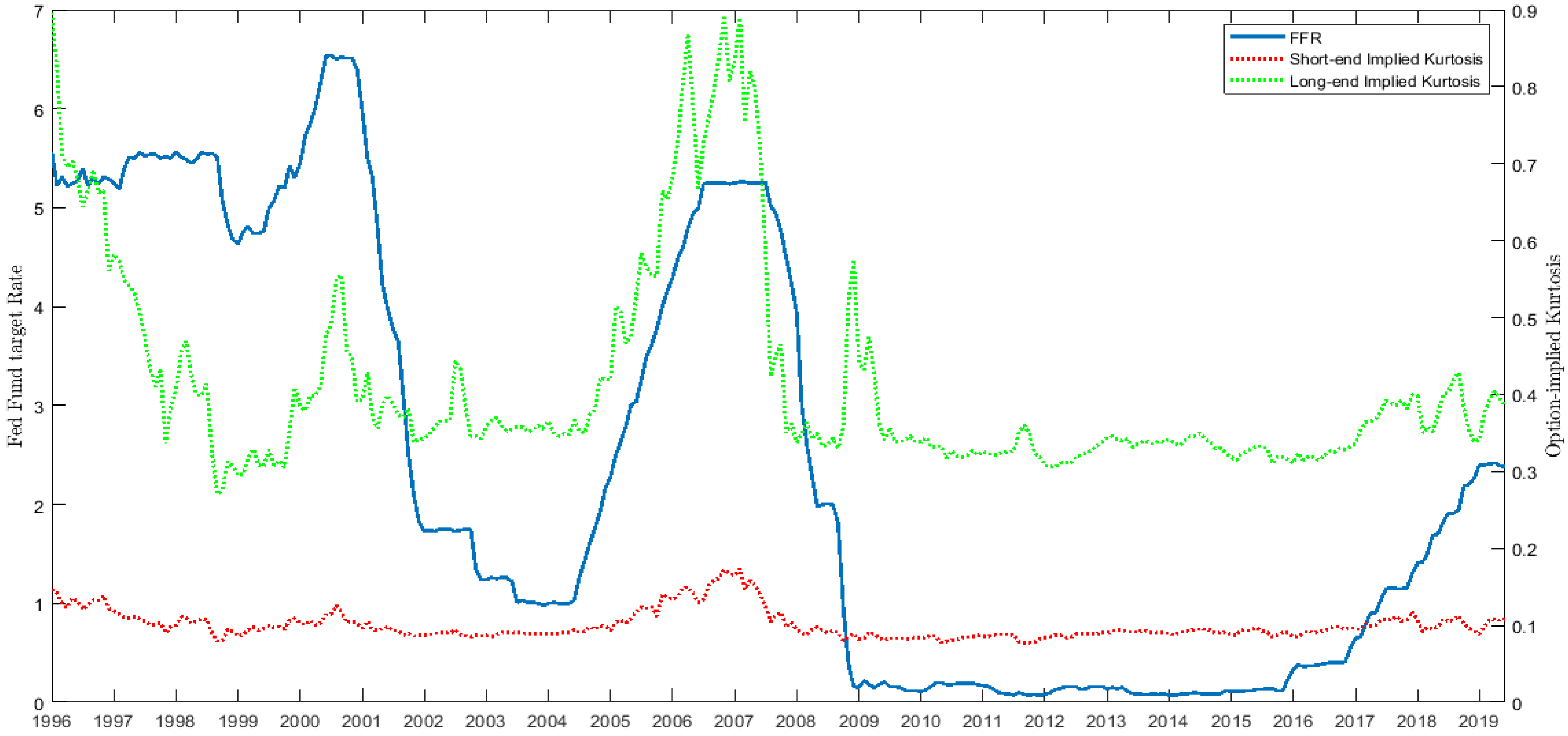
Plot of the monthly short-end and long-end components of the option-implied skewness and the fed fund rate



Plot of the monthly level of the option-implied kurtosis and the fed fund rate

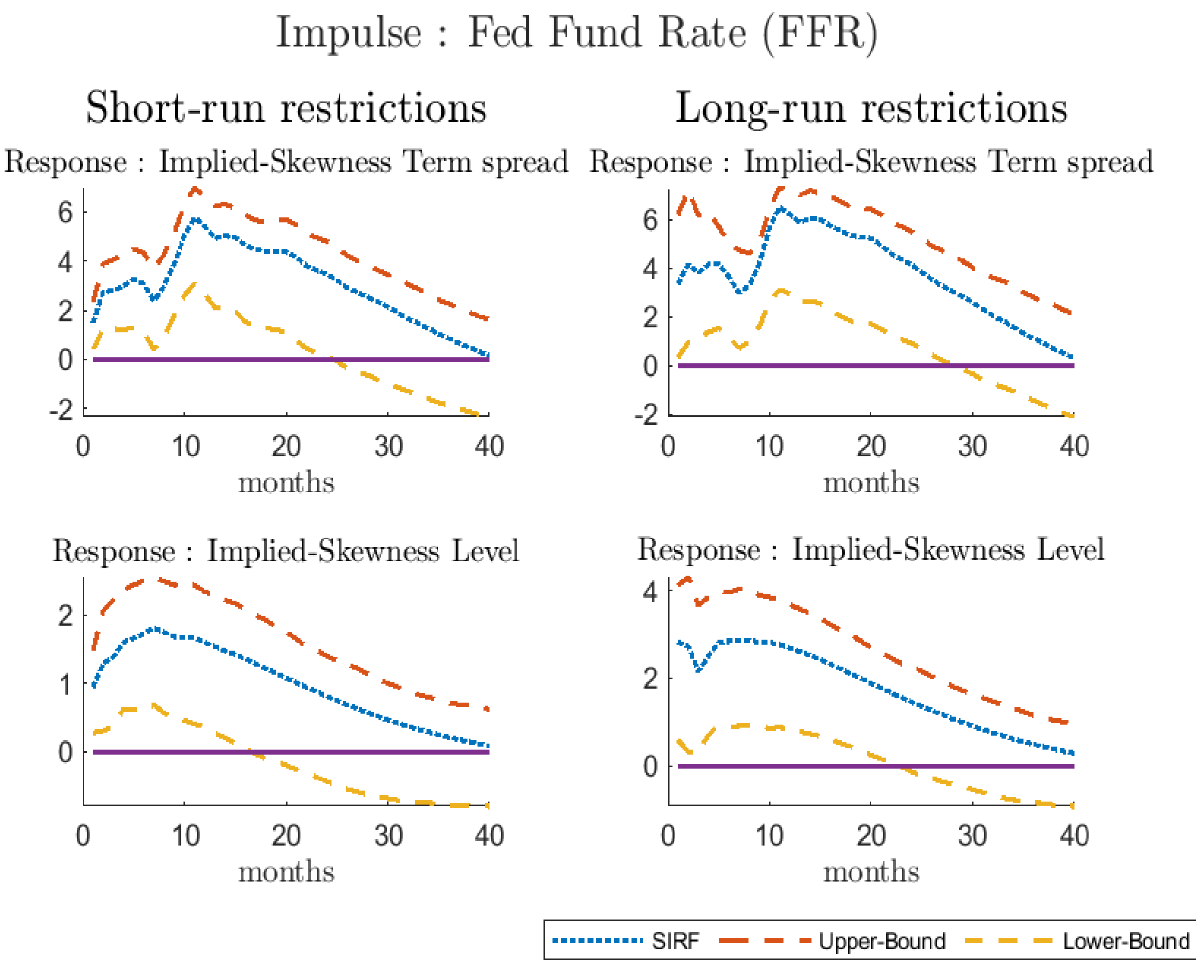


Plot of the monthly short-end and long-end components of the option-implied kurtosis and the fed fund rate

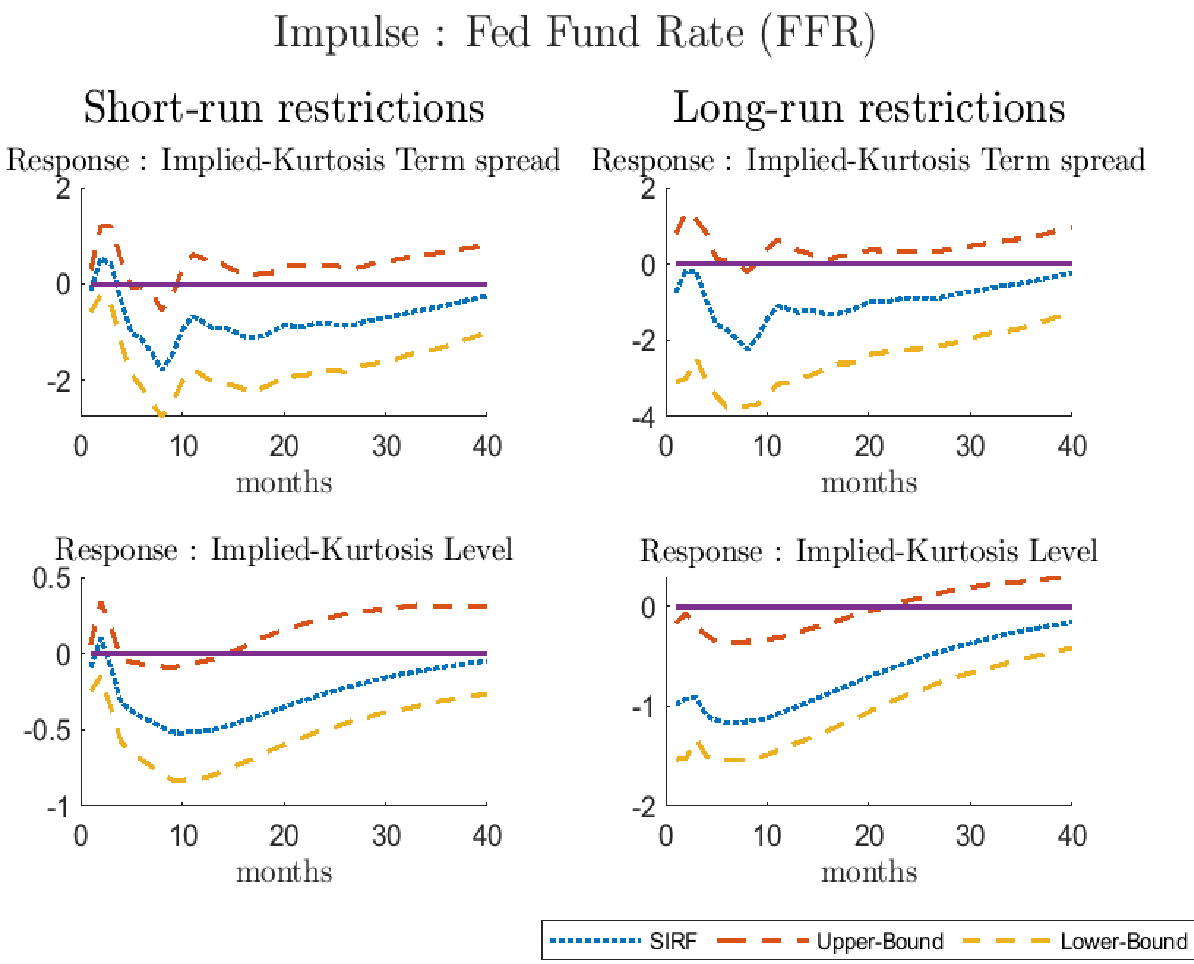


SIRFs of term spread and level of IS/IK to negative FFR shocks (expansionary MP shocks), for multivariate SVAR model

Option Implied Skewness

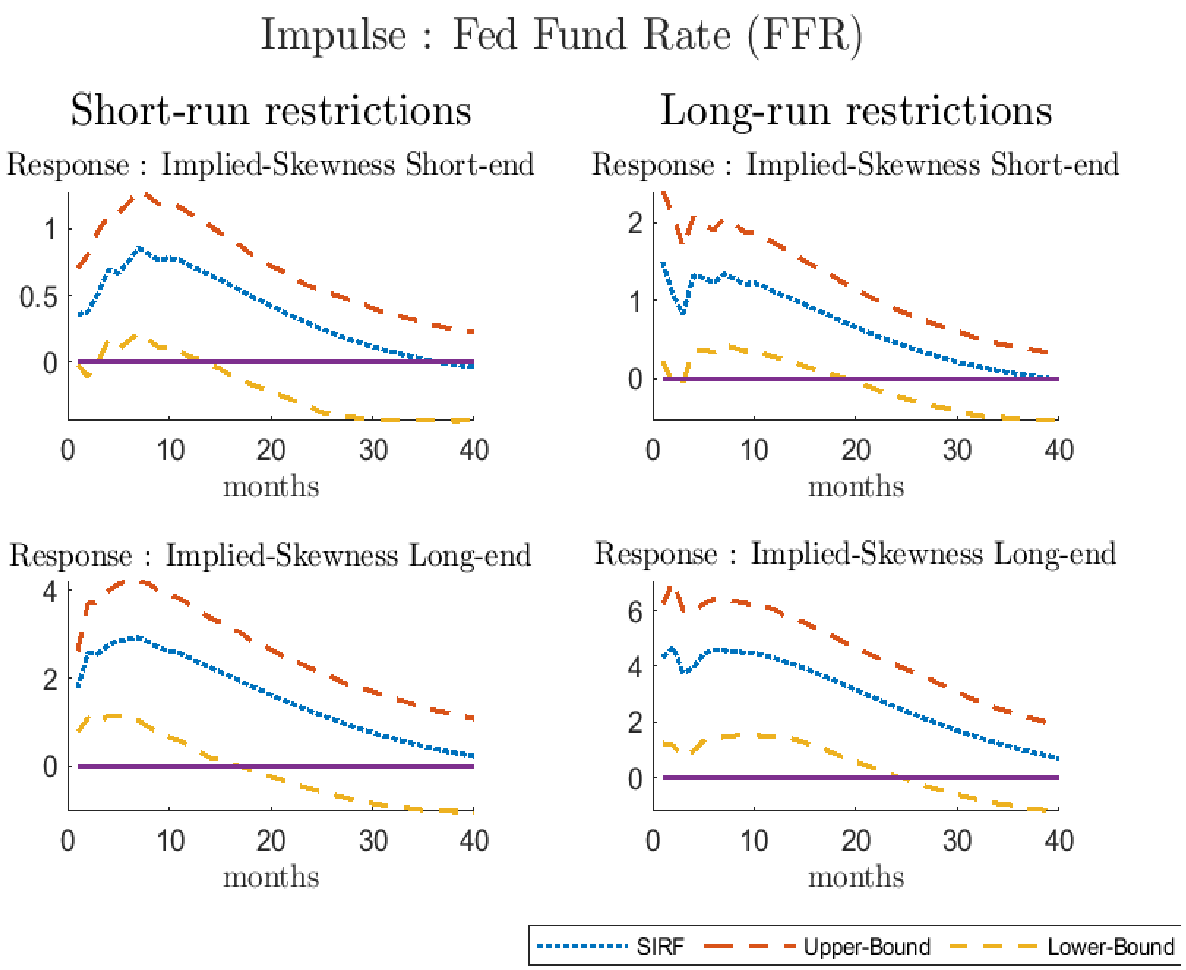


Option Implied Kurtosis

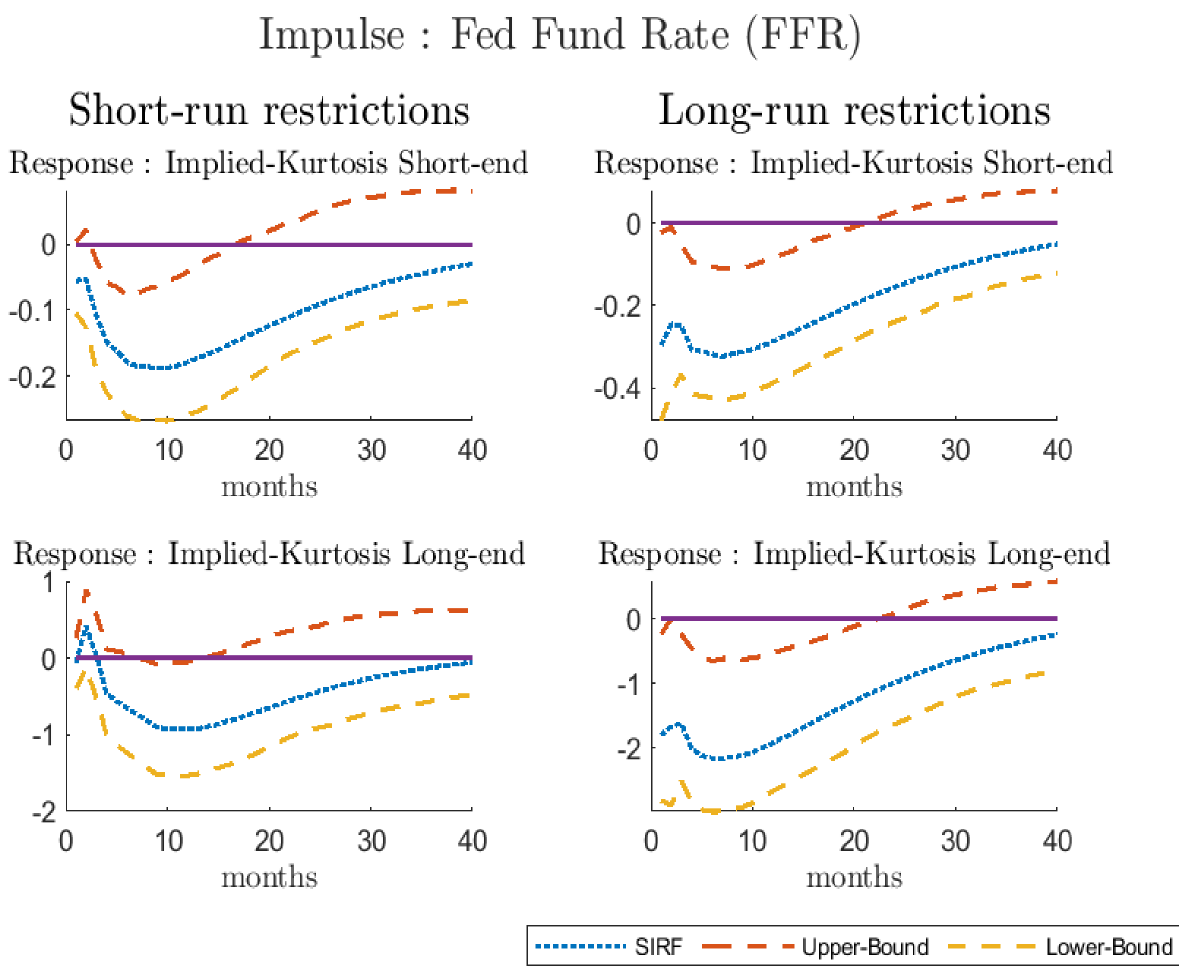


SIRFs of short-end and long-end of IS/IK to negative FFR shocks (expansionary MP shocks), for multivariate SVAR model

Option Implied Skewness

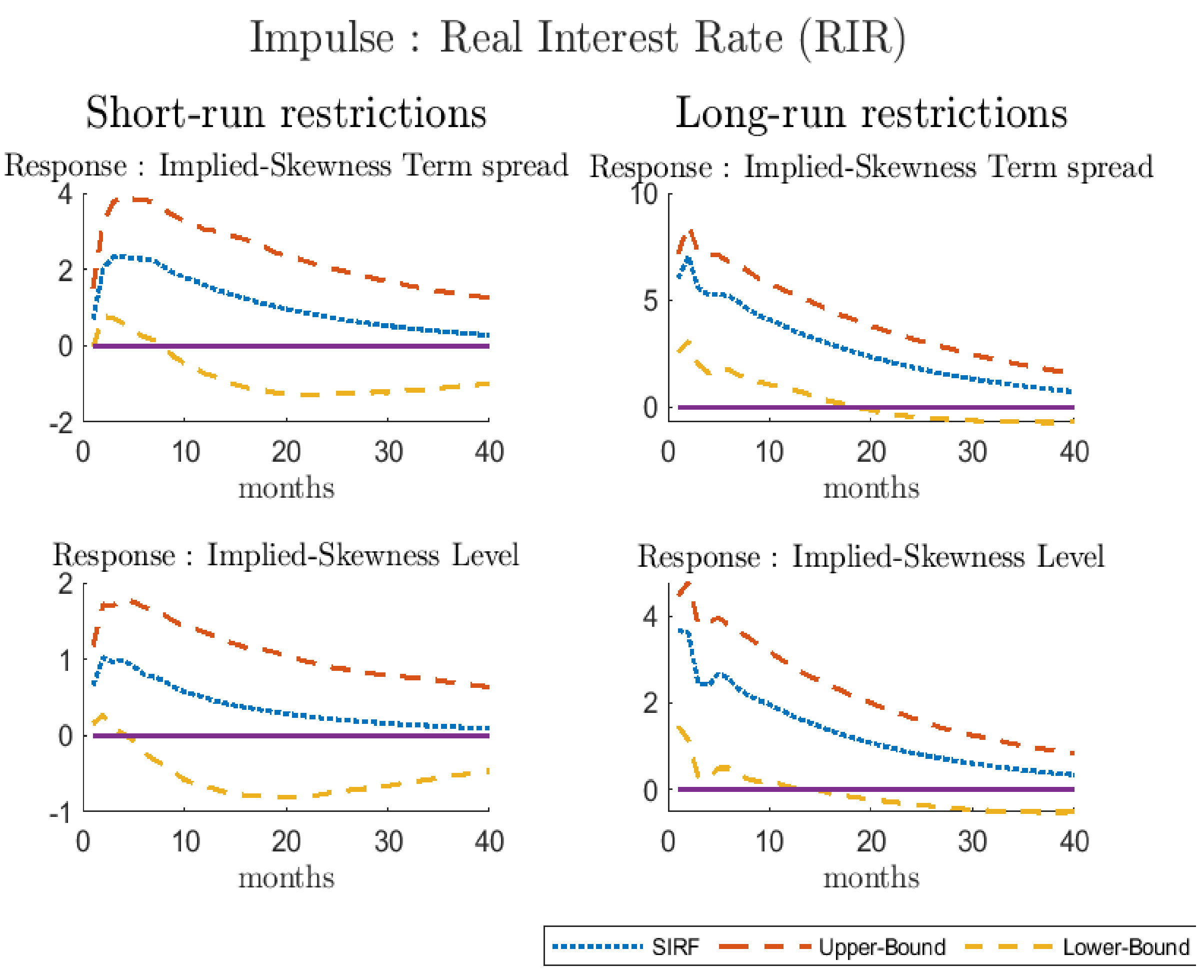


Option Implied Kurtosis

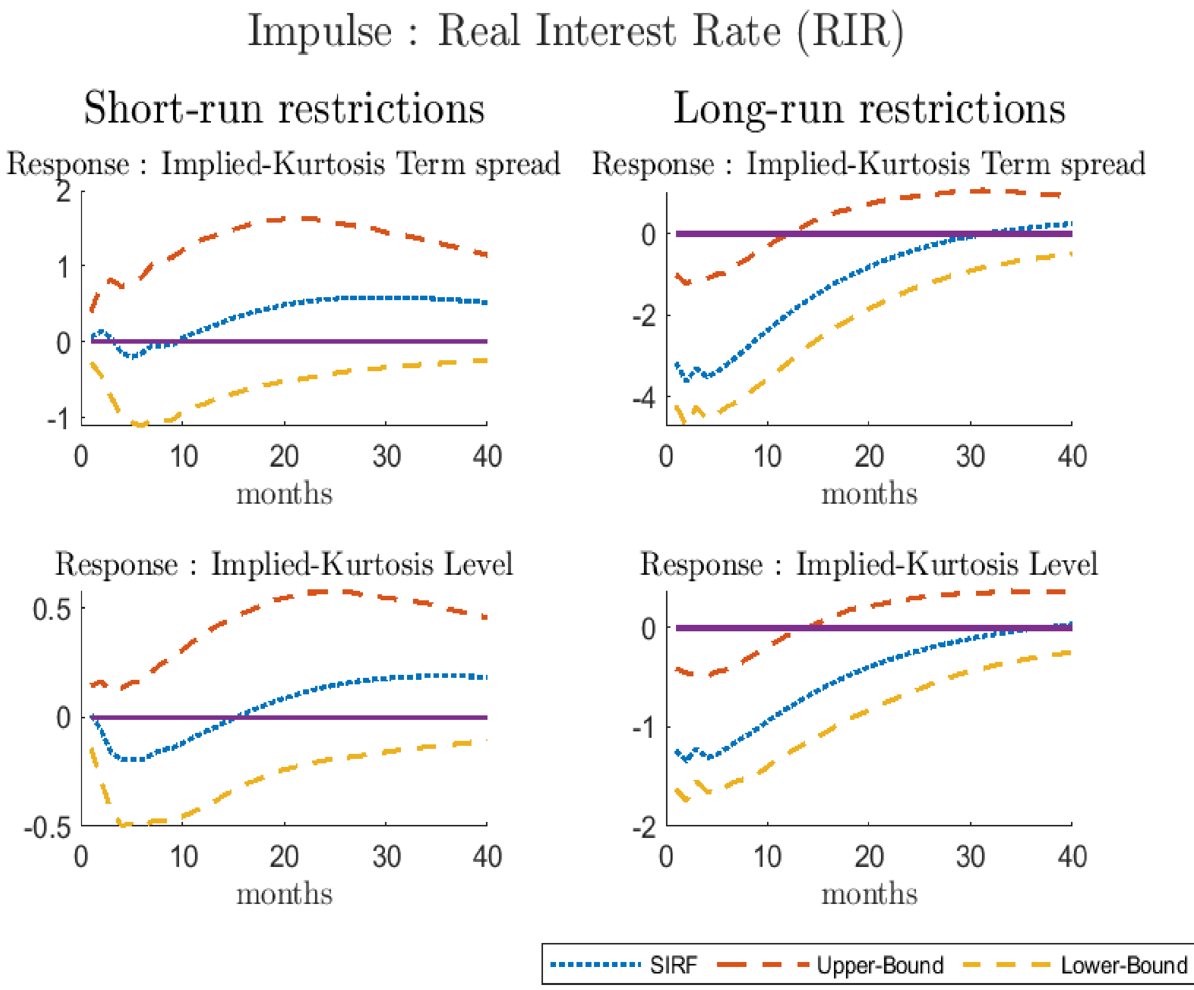


SIRFs of term spread and level of IS/IK to negative RIR shocks (expansionary MP shocks), for multivariate SVAR model

Option Implied Skewness

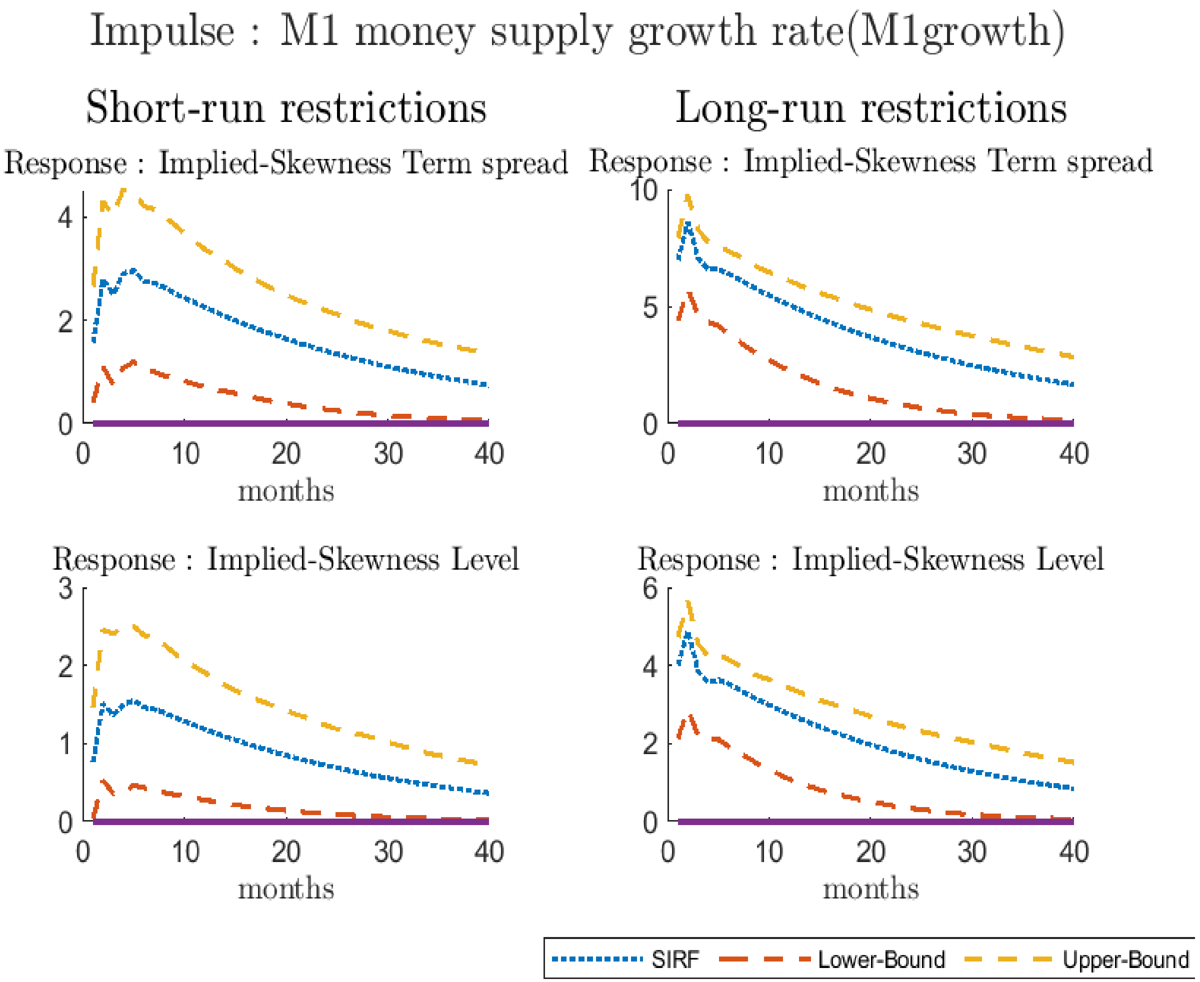


Option Implied Kurtosis

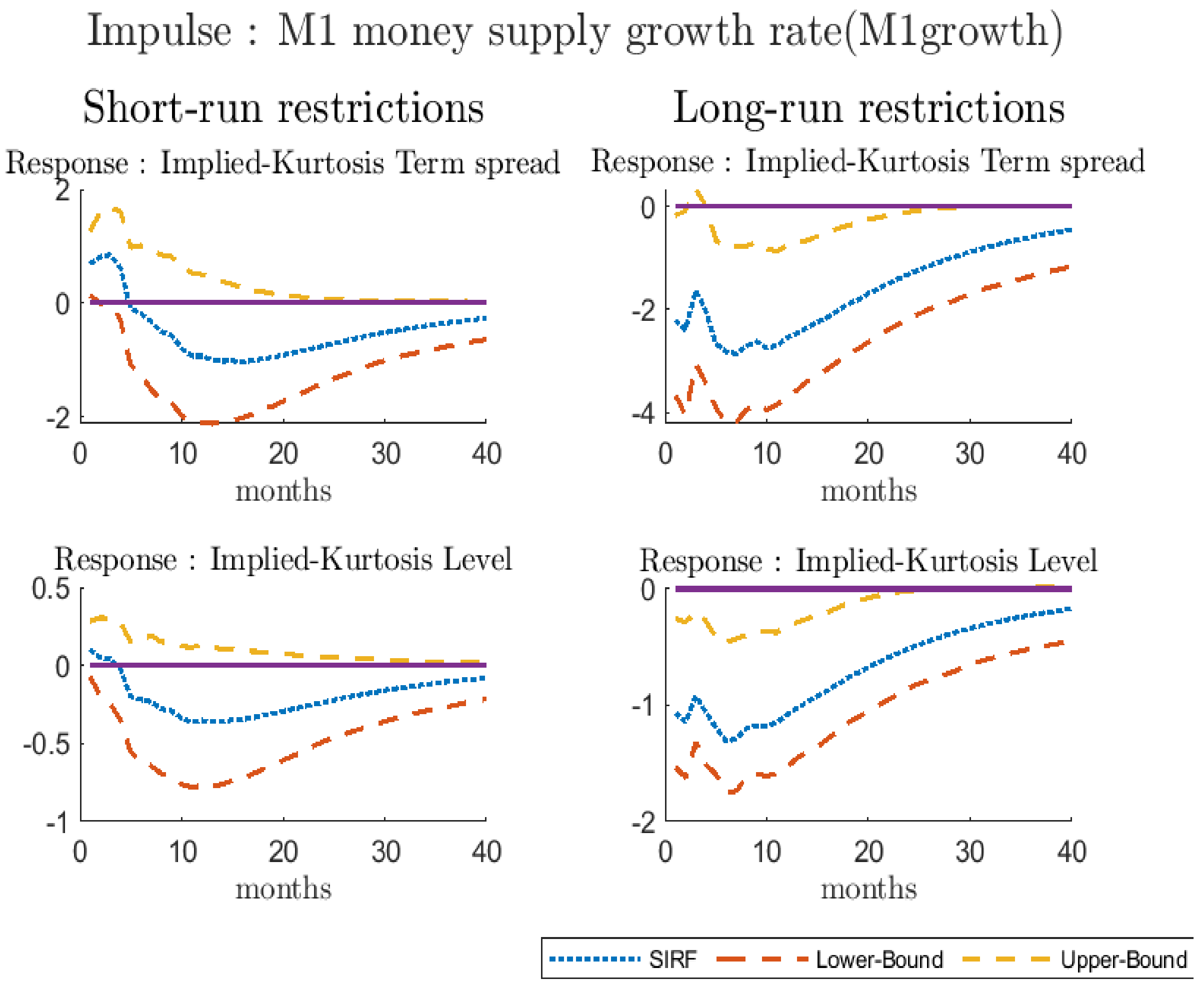


SIRFs of term spread and level of IS/IK to positive M1growth shocks (expansionary MP shocks), for multivariate SVAR model

Option Implied Skewness

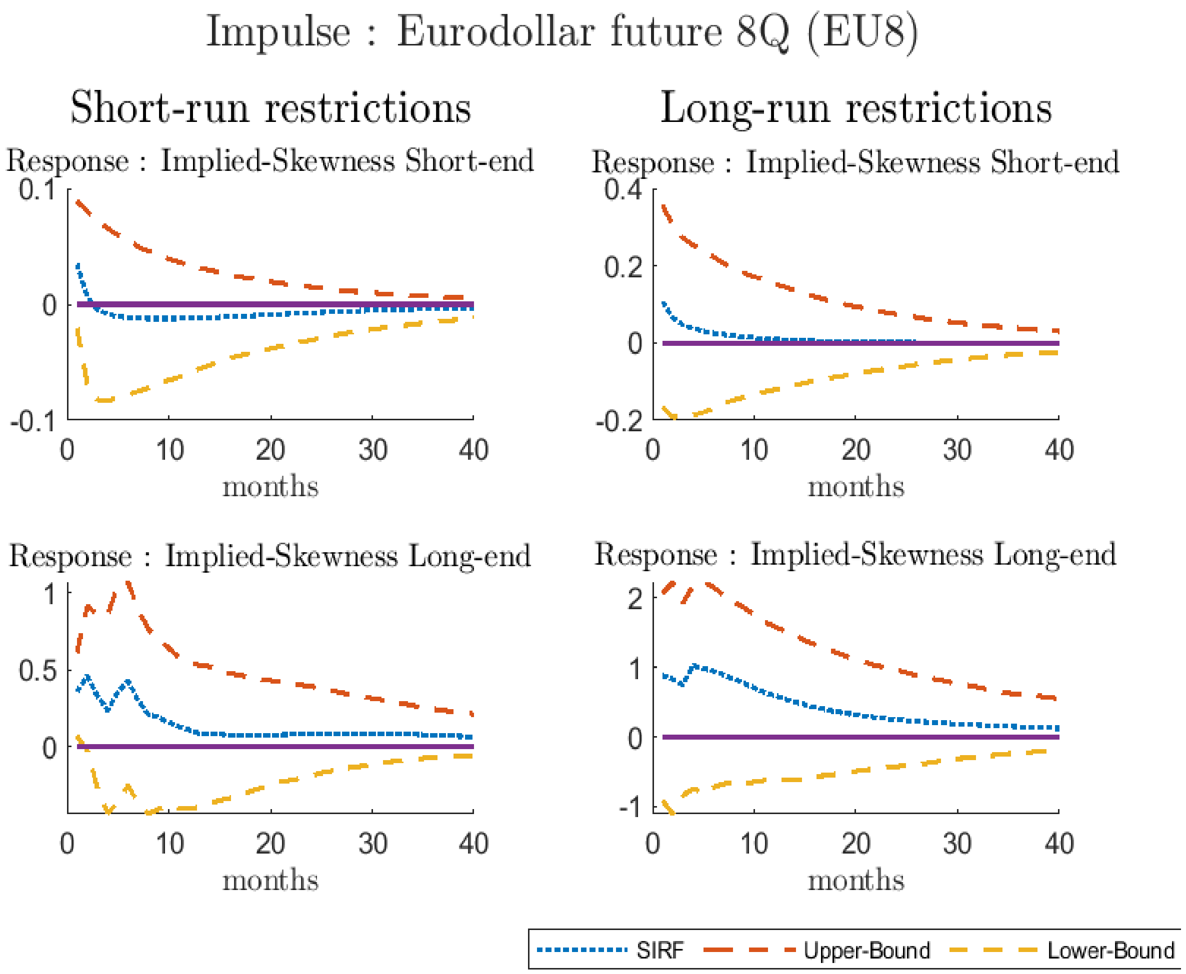


Option Implied Kurtosis

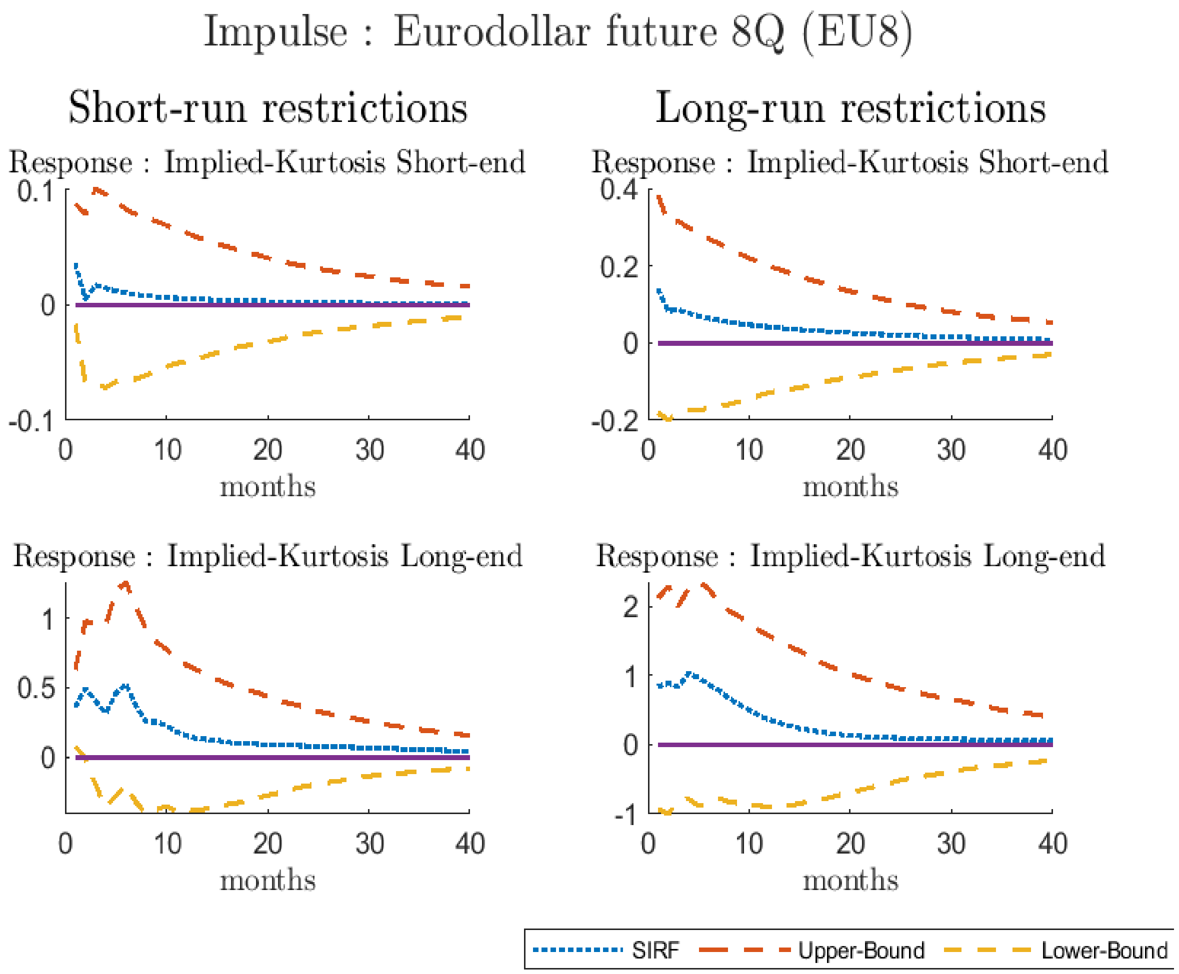


SIRFs of term spread and level of IS/IK to negative 8-quarter Eurodollar contracts shocks (expansionary MP shocks), for multivariate SVAR model

Option Implied Skewness



Option Implied Kurtosis



Conclusions

The conclusions of our paper that can have a strong policy implication are :

- Our empirical results provide further evidence about the risk-taking channel of monetary policy and the existence of the “Fed put” by finding that accommodative policy affects investors’ expectations regarding the stock market subsequent performance
- We find that policy makers are not only able to influence investors’ expectations about the subsequent market performance, but more significantly, they are capable of shaping expectations about the long-term horizon.